TABLE 2.—*Times of crests and hollows of waves of first and second preliminary tremors.*[3]

Wave No.	E.-W. h.	m.	s.	Difference. Sec.	N.-S. h.	m.	s.	Difference. Sec.	Remarks.
1	1	14	23	.....	1	14	21	.....	Crest of first preliminary tremor.
2			34	11			32	11	
3			43	9			41	9	
4			53	10			53	12	
5			62	9			67	14	
6			81	19			79	12	
7			90	9			87	8	
8			99	9			95	8	Ripples begin.
9			117	18			117	22	
10			131	14			131	14	
11			.....	.....			.....	.....	Interval of partial rest with ripples.
12	1	18	0	.....	1	17	58	.....	Waves Nos. 12 to 23 are almost wholly absent in the N.-S. component.
13			11	11	1	18	11	13	
14			21	10			17	6	
15			30	9			31	14	
16			41	11			40	9	
17			51	10			47	7	
18	1	19	2	11	1	19	2	15	
19			11	9			11	9	
20			16	5			17	6	
21			21	5			20	3	
22			24	3			23	3	
23			29	5			28	5	Beginning of second preliminary tremor well defined.
24			39	10			37	9	
25			47	8			42	5	
26	1	20	0	13			56	14	
27			7	7	1	20	7	11	
28			21	14			25	18	
29			27	6			30	5	
30			40	13			34	4	
31			52	12			37	3	
32			57	5			42	5	
33	1	21	3	6			47	5	
34			7	4			50	3	
35			13	6			53	3	
36			24	11			59	6	
37			31	7	1	21	7	8	
38			40	9			20	13	
39			44	4			34	14	
40			51	7			43	9	
41	1	22	3	12			49	6	
42			20	17	1	22	3	14	
43			30	10			12	9	
44			38	8			21	9	
45			45	7			30	9	
46			56	11			40	10	
47	1	23	3	7			50	10	
48			13	10	1	23	0	10	
49			20	7			3	3	
50			30	10			15	12	
51			41	11			22	7	
52			55	14			53	31	
53	1	24	4	9	1	24	9	16	
54			25	21			26	17	
55			35	10			39	13	
56			51	16			52	13	
57	1	25	0	9	1	25	2	10	
58			17	17			15	13	
59			25	8			30	15	
60			42	17			45	15	
61			....	.....			49	4	
62			..	.....	1	26	0	11	
63			....	.....			4	4	
64			....	.....			11	7	
65			....	.....			19	8	
66			....	.....			36	17	
67			....	.....			55	19	Beginning of principal portion.

The agreement in times of the wave crests and hollows is noticeably close thruout the first five minutes, as also in the first waves constituting the second preliminary tremors. But discordance soon develops, (at No. 28) and the records can not be said to admit of any very definite interpretation.

There is a noticeable tendency for the wave periods to become longer toward the end of the second preliminary tremors.

From a consideration of all the facts at our command in this connection, we may be warranted in making the following statements in regard to the real nature of the motion of the seismograph pier at the time of registration of the preliminary tremors of the earthquake in question.

1. That all the waves of the first preliminary tremors appear to have produced vibrations of the pier north-east and southwest, and that the first initial motion was a very small motion toward the northeast, followed by a considerably larger displacement to the southwest, and again to the northeast, with a distinct subsidence after one or two complete waves of all motion, except of very small amplitude.

2. That after an interval of about a minute and a half, a series of ripples, or waves of small amplitude and period prevailed for nearly two minutes, followed by much slower waves of small amplitude, just preceding the arrival of the second preliminary tremors.

3. That the second preliminary tremors appear to be exactly the same in character as the first preliminary tremors, except stronger; that is to have caused the pier to move first slightly to the northeast, then much more to the southwest; again to the northeast, and so on. Here, again, the motion distinctly subsides, relatively, but the records indicate more complex motion, and I think we are warranted in assuming that the original longitudinal vibrations northeast and southwest are becoming complicated, possibly with transverse vibrations.

Altho the records are very clearly defined and inscribed, yet the smallness of the time scale, and the inherent defects of seismographic action render it impossible to arrive at any definite further interpretation of the records.

These relatively negative and incomplete conclusions emphasize the necessity for still further development of seismic apparatus. The records in the present case seem practically perfect. In the originals the smallest details are perfectly clear and definite. The difficulty arises from the failure of the steady mass to remain at rest. The relation between its motion and that of the ground is complicated and unknown. Mathematical analysis of the problem enables us to formulate certain analytical relations between the motion of the steady mass and that of the ground, but at the best these necessarily involve certain assumptions as to the ground motion, the damping of the pendulum, etc., that are not justified in nature.

In actual practise it is difficult to realize a sufficiently long period for the steady mass and to render it truly aperiodic under a strictly exponential law.

In the opinion of the writer these are the objects to be striven for in the further development of seismographs.

[3] The times are taken directly from the record sheet. A correction of four seconds must be added to obtain true seventy-fifth meridian time.

NEW JAPANESE SEISMOLOGICAL PUBLICATIONS.

By C. F. MARVIN, Professor of Meteorology. Dated May 22, 1907.

The Imperial Earthquake Investigation Committee of Japan has been a very large contributor to modern seismology and its literature, and the so-called "Publications of the Earthquake Investigation Committee in Foreign Languages" are consulted by all seismologists thruout the world. The committee has very recently issued the first and second numbers of a new series of publications entitled: "Bulletin of the Imperial Earthquake Investigation Committee".

The following quotation from the preface of Vol. I, No. 1, dated January, 1907, explains the object and scope of the Bulletin:

> The object in issuing the Bulletin is to secure quick publication of short notes and preliminary reports on seismological subjects, more especially such contributions as may be of use in connection with the works of the International Seismological Association. The Publications which contain more lengthy papers will be issued from time to time as heretofore.

Numbers 1 and 2 of the Bulletin before us contains a collection of short notes by Doctor Omori treating of individual topics concerning one or more of the recent great earthquakes. In fact, it seems appropriate to give here the titles of the several notes, as follows:

"On the estimation of the time of the occurrence at the origin of a distant earthquake from the duration of the first preliminary tremor observed at any place".

"On the methods of calculating the velocities of earthquake propagation".

"Preliminary note on the cause of the San Francisco earthquake of April 18, 1906".

"Preliminary note on the seismographic observations of the San Francisco earthquake of April 18, 1906".

"Note on the transit velocities of the Guatemala earthquake of April 19, 1902".

"The Calabrian earthquake of September 8, 1905, observed in Tokyo".

"Preliminary note on the Formosa earthquake of March 17, 1906".

"Comparison of the faults in the three earthquakes of Mino-Owari, Formosa, and San Francisco".

"Note on the transit velocity of the Formosa earthquake of April 14, 1906".

"Notes on the Valparaiso and Aleutian earthquakes of August 17, 1906".

"On the distribution of recent Japan earthquakes".

In the several papers treating of the transit velocities of earthquake waves and formulas for computing times of earthquakes at the origin, etc., Doctor Omori to a certain extent revises results of earlier studies on similar topics already set forth in the Publications. The revision is based on new data and observations supplied by the recent great earthquakes in India, Calabria, Formosa, North America, and South America, and, naturally, the results differ appreciably from previous determinations.

We wish to call attention to a factor in connection with this question of speed of propagation that appears to have been generally disregarded, and is not recognized in Doctor Omori's studies.

The point in question is best illustrated by reference to the California earthquake, in respect to which certain definite facts bearing on the question are brought out from reports that have been rendered. It appears that fully thirty to thirty-five seconds elapsed after the first slight tremors were felt by careful observers located within a few miles of the fault line before the occurrence of the strong and destructive motion. Making all reasonable allowance for the existence of slight preliminary tremors for a short period corresponding to the short distance of the observers in question from the fault line, the writer is forced to the conclusion that the seismic action at the fault line during the first thirty or more seconds was of relatively inconsequential intensity. If the earthquake had ended at this phase no great records would ever have been made at distant stations, such as Tokyo, Washington, and those thruout Europe. In other words the distant records are to be correlated not with the feeble beginnings of the seismic action, as observed near the fault line, but with the strong and destructive motion. Upon this basis the waves which first reached distant stations like Washington and Tokyo originated at the fault line at the time of the beginning of *the destructive motion*, and not at the time of the motions felt first. According to the best information in the possession of the writer this time was 5 h., 12 m., 33 s., one hundred and twentieth meridian time.

Doctor Omori places the time of beginning of the earthquake at the fault line at 5 h., 12 m., 0 s. Evidence is not at hand to show that action was appreciably earlier at one part of the fault line than the other. It appears to have been nearly simultaneous at all points.

Different earthquakes must differ greatly in regard to the sequence of relative intensities thruout the entire duration of the tectonic action at the origin, and it seems that if the facts are carefully determined in each case and considered in accordance with the foregoing statements, some of the existing discordance in transit times and speeds might be harmonized.

TORNADO OF APRIL 5, 1907, IN ESCAMBIA COUNTY, FLA.

By WM. F. REED, jr., Observer. Dated Pensacola, Fla., May 8, 1907.

The morning weather map of April 5 showed an area of low barometric pressure over southern Arkansas, with a central depression of 29.65 inches; this storm moved eastward, with general rains, and past over northern Alabama during the afternoon of the 5th, reaching western North Carolina on the morning of the 6th.

The conditions at Pensacola on April 5 were stormy; the temperature ranged between 66° and 73°; the barometer (sea-level) fell from 29.96 at 12:01 a. m. to 29.68 at 7 p. m., and began to rise at 8:15 p. m.; winds were fresh to brisk southerly in the morning, high south to southwest between 12 noon and 9 p. m., and brisk southwest to west 9 p. m. to 12 midnight; at 3:33 p. m. the wind reached 43 miles from the south; at 5:28 p. m., 44 miles southwest; at 6:23 p. m., 45 miles southwest, and at 7:17 p. m., 40 miles southwest: clouds were of the lower types thruout the day and moved from the west and southwest; it became very threatening many times in the afternoon and evening, with passing light showers; cloudiness alternated rapidly from clear to cloudy between 7 and 9 p. m., becoming permanently clear by 9:30 p. m.; lightning was seen in the north at intervals from 6:30 to 7 p. m., then flashed from northwest around to southeast, continuing in the southeast after 11:30 p. m.; thunder was noted in the northwest at 9 p. m. The tide at Pensacola, caused by the high southerly winds, was 18 inches above normal high water. The estimated damage from this storm in Pensacola was $1000, viz, the amount that it cost the timber merchants to gather the timber that was cast ashore. Southwest storm warnings were displayed early in the afternoon.

Mr. J. H. Patterson, of Muscogee, Fla., gives the following account and exact track of the tornado as it coursed thru the woodland, deviating somewhat to the right or left of a straight line:

The storm crost the line of Florida and Alabama in section 6, township 3 north, range 33 west, traveled southeast, past along the line between sections 6 and 31, in township 4 north, range 33 west, on thru the south half of 32 and north half of 33, southeast quarter of 28, center of section 27, north quarter of section 26; demolished house of Mr. George Locke in northeast quarter of section 26 about 5:45 p. m., past thru south half of section 24; in township 4, range 32, it went thru north half of section 19, on thru northwest quarter of section 20; in southwest quarter of section 17 it demolished a house belonging to Mr. James Lambert three or four minutes after it struck the Locke house; next it struck Mr. Steward's place and I can not give its track from there. The cloud was funnel shaped and lookt like smoke mixt with steam; no lightning; no rain. It sounded like a heavy freight train and traveled generally southwest to northeast. The presence of a whirl was evidenced by the position of fallen trees, those in the center of the path lying southwest to northeast; on the south side, northwest to southeast, and on the north side, southeast to northwest; width of path, 900 feet.

The following was obtained from an interview with Mr. J. R. Steward:

The day was cloudy and unusually windy; aside from this there was no marked indication of anything more than an ordinary rainstorm approaching until late in the afternoon, when conditions grew threatening; and a few minutes before 6 p. m. a sound like two or three passenger trains was heard roaring with increasing fury from the west. In the house with me there were seven other men whom I had employed to work about the place. We lookt to the westward and beheld the storm approaching; it seemed as tho a dense black smoke was rolling toward us over the ground; and as it came closer I saw in this dense mass dimly outlined the funnel-shaped cloud, the tail of which seemed to be thrashing, plowing, and upsetting everything in its pathway. Upon the impulse of the moment we all realized that we were in a dangerous position and ran for our lives, but while we were running the storm was upon us. I made for the open, knowing that not far away there was a pit where possibly I would escape injury by allowing the storm to pass over me. While in the act of climbing the fence a gust of wind picked me up and carried me about fifty feet; while I was being carried a piece of flying débris struck me on the top of the head, cutting a gash in my scalp three inches long and knocking me senseless; and when picked up I was told that I was raised ten feet or more from the ground. Two of the men got under a log wagon, which was carried along some distance, and escaped injury. The men that did not cling to trees or posts were carried about by the wind. One man was carried a distance of 200 yards, receiving only slight bruises. A carpenter clung to a mulberry tree at the corner of a two-story barn (indicated on accompanying map, fig. 1, at *b*); the barn with the exception of the sills was blown away; the carpenter, altho pinned to the ground by the tree and timbers, on top of